

ences might thus be related to biases specific to the study designs.

The small risk associated with coffee consumption might be explained by residual confounding. If caffeine were a causal agent, we would have suffered loss of power from lack of information on other caffeine intake. However, nutrition survey data show total caffeine intake and coffee consumption to be highly correlated ($r = .98$) in Quebec women (Health and Welfare Canada, personal communication). Evidence of an association between caffeine consumption and early fetal loss has been reported,¹⁵ but no such association has been reported, so far as we are aware, with spontaneous abortion.

If the observed associations were causal, cigarettes accounted for about 11% of all spontaneous abortions (40% in women who smoked 20 or more cigarettes per day), alcohol consumption for about 5% (45% in women drinking 3 or more drinks per day) and coffee for about 2% (16% in women drinking 10 cups per day).

These risks warrant concern among public health professionals.

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Cigarette, Alcohol, and Coffee Consumption and Prematurity

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ABSTRACT

We analyzed data from a survey of occupational and other factors in pregnancy to assess the effects of cigarette, alcohol, and coffee consumption on pregnancy outcome. The risk of low birth weight for gestational age was found to increase substantially with smoking. Occasional consumers of alcohol had a slightly reduced risk relative to total abstainers. In more frequent drinkers, there was a small increase in risk. Risk increased slightly with coffee consumption. (*Am J Public Health*. 1992;82:87-90)

Introduction

The reduction in birth weight that accompanies maternal smoking in pregnancy, first reported in the 1950s,^{1,2} has been well established.^{3,4} Studies of alcohol⁵⁻¹² and caffeine¹³⁻¹⁶ consumption have given conflicting findings. We used data from a survey in Montreal of occupational and other factors in pregnancy to examine the effects of smoking and consumption of alcohol and caffeine on pregnancy outcome. The survey is described briefly in the first of this series of papers and in detail in earlier reports.¹⁷⁻²⁰

Methods

The present analysis was confined to current (just-completed) single pregnancies. Of the 51 512 pregnancies, 10 364 were excluded because of factors known to affect length of gestation and birth weight: multiple pregnancy (475), induction of labor (6113), hypertension (1187),

diabetes (154), and prenatal bleeding or illness (2435). For another 362 women smoking, alcohol, or coffee consumption were unknown, and for 341 outcome information was incomplete, leaving 40 445 pregnancies for analysis.

To separate factors that affect fetal growth from those that diminish length of gestation, we defined prematurity in three ways: (1) low birth weight (≤ 2500 g), (2) preterm birth (< 37 weeks), and (3) low birth weight for gestational age (LBWGA; bottom 5%).

The overall rates among the pregnancies surveyed were as follows: low birth

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TABLE 1—Risk of Prematurity by Maternal Characteristics

	n	Low Birth Weight		LBWGA		Preterm Birth	
		%	OR	%	OR	%	OR
Age							
< 20 years	1 627	8.2	1.00	8.1	1.00	10.3	1.00
20–29	27 557	5.8	1.10	5.4	1.13	6.7	0.74
30–34	8 661	4.8	1.18	4.3	1.28	6.7	0.79
35+	2 600	5.4	1.44	4.1	1.36	7.9	0.92
Pregnancy order							
1	19 096	6.0	1.00	6.2	1.00	6.4	1.00
2	12 909	5.2	0.67	4.3	0.60	7.1	0.93
3	5 485	5.6	0.66	4.2	0.60	8.0	0.95
4+	2 955	5.4	0.52	4.0	0.63	8.2	0.81
Previous spontaneous abortion							
None	34 425	5.4	1.00	5.2	1.00	6.6	1.00
One or more							
At 2nd pregnancy	1 771	8.4	2.13	6.5	1.73	8.7	1.51
At 3rd pregnancy	2 273	6.6	1.44	4.7	1.18	8.8	1.32
At pregnancy 4+	1 976	6.1	1.50	4.1	0.96	8.9	1.36
Previous low-birth-weight infant							
None	38 955	5.3	1.00	5.1	1.00	6.4	1.00
One or more							
At 2nd pregnancy	618	14.4	3.76	5.3	1.28	22.8	4.59
At 3rd pregnancy	463	14.7	3.16	6.3	1.33	21.8	3.81
At pregnancy 4+	409	13.2	3.06	5.9	1.31	19.3	3.28
Prepregnancy weight							
< 52 kg	15 339	8.1	1.00	7.7	1.00	8.0	1.00
52–58 kg	13 496	4.7	0.62	4.1	0.56	6.6	0.86
> 58 kg	11 610	3.6	0.47	3.1	0.42	6.0	0.76
Ethnic Group (color/language)							
White/English	7 221	3.3	1.00	3.5	1.00	5.3	1.00
White/French	25 959	6.1	1.44	5.6	1.21	7.0	1.21
Other	7 235	6.5	1.93	5.2	1.47	8.4	1.56
Education completed							
< Secondary	9 551	8.2	1.00	7.6	1.00	8.8	1.00
< College	17 387	5.7	0.84	5.1	0.80	7.2	0.92
College	13 507	3.8	0.69	3.5	0.68	5.3	0.72
Employment at start of pregnancy							
Unemployed	16 524	6.0	1.00	5.2	1.00	7.6	1.00
Employed	23 921	5.4	0.99	5.1	1.02	6.5	0.99
All	40 445	5.7		5.2		7.0	

Note. LBWGA = low birthweight for gestational age. OR = odds ratio, estimated by logistic regression with all factors, including cigarette, alcohol, and coffee consumption, in the model.

weight 5.7%, preterm birth 7.0%, LBWGA 5.2% (Table 1). To investigate the dependence of these three measures on the factors of interest, we used logistic regression, adjusting for the confounding factors shown in Table 1.

Results

Smoking

The risk of all three measures of prematurity, especially LBWGA, was higher among smokers than nonsmokers, and increased with number of cigarettes smoked ($P < .001$) (Table 2). For every 10 cigarettes smoked per day, the risk of LBWGA increased by a factor of 1.51 (95% CI,

1.44–1.57). Smoking accounted for 39% of cases of LBWGA, 35% of cases of low birth weight, and 11% of preterm births.

We investigated risk according to changes in smoking habits only for low birth weight. Women who smoked before but not during the first trimester had no excess risk (Table 3). Risk was also consistently reduced in women who cut down their consumption. Cessation before the second trimester brought the risk close to that for nonsmokers (Table 4). It is less clear that continued but reduced consumption was associated with a reduction in risk.

Mean placental weight varied little with smoking. For nonsmokers it was

626.6 g; for smokers of 1 to 9 cigarettes daily, 617.8 g; for 10 to 19 cigarettes, 618.7 g; and for 20 or more, 614.8 g. Accounting for birth weight, the placentas of smokers were a little heavier than those of nonsmokers; for example, the adjusted mean weight for heavy smokers was 30 g more than for nonsmokers.

Alcohol

For all three outcomes, light consumers of alcohol had a small but statistically significant reduction in risk relative to total abstainers (Table 5). Risk then appears to increase with alcohol intake, especially for low birth weight ($P = .002$ for trend). We examined risk of low birth weight by type of alcohol. After controlling for number of drinks, we found that risk was higher by a factor of 1.24 (95% CI, 1.00–1.53) for beer drinkers, and by a factor of 1.38 (95% CI, 0.96–1.99) for drinkers of spirits, than for wine drinkers.

Coffee

Trends of increasing risk with coffee consumption were consistent for low birth weight ($P = .02$) and LBWGA ($P = .01$), reaching a peak at a factor of about 1.4 in women consuming 10 or more cups per day (Table 6). Risk of LBWGA increased by a factor of 1.04 (95% CI, 1.01–1.06) per cup of coffee per day. If these associations were causal, coffee would account for 6% of cases of LBWGA, and 4% of cases of low birth weight.

Interactions

Interactions between smoking, alcohol, coffee, and other variables were seldom substantial but often statistically significant ($P < .05$). For LBWGA, the risk of smoking was apparently greater for French-speaking women than for others by a factor of 1.55 (95% CI, 1.17–2.05); that of alcohol consumption was 1.35 times greater for mothers over 30 (95% CI, 1.08–1.69); that of coffee consumption was 1.27 times greater for alcohol consumers than for abstainers (95% CI, 1.02–1.60).

Discussion

A reduction in birth weight was found that was consistent with previous reports that infants of smokers weighed on average 150 to 250 g less than those of nonsmokers.³ There was a quantitative relationship with the number of cigarettes smoked. Our exploration of interactions indicated that this relationship was not importantly influenced by any other factor. A slightly shorter gestation period, a mat-

ter of a day or two, was found in smokers in our study, as in others. The somewhat greater effect of smoking on birth weight corrected for gestation length than on uncorrected birth weight indicates that smoking directly retards fetal growth. The higher ratio of placental to infant weight that we found in smokers has also been observed by others.²¹⁻²³ Our finding that women who stopped smoking during the first trimester had little or no greater risk of having a low-birth-weight infant than did nonsmokers, together with other similar findings,^{9,24,25} is important.

In contrast, the evidence for alcohol as a risk factor was unconvincing. Women who took fewer than seven drinks a week had fewer low-birth-weight babies than did those who drank more than this or those who drank no alcohol. This result is consistent with the finding of higher average birth weights in babies born to women who drank alcohol than in those who did not.¹¹ Two studies have been reported, one in Britain⁷ and another in the United States,⁸ in which retarded fetal growth was significantly more frequent when 10 or more drinks a week were taken. In France, an increase in small-for-dates babies was found among women who drank three or more drinks a day, but only in women who were mainly beer drinkers.⁵ In our study also, such risk as there was predominantly affected beer and spirits drinkers. Our study and two others^{9,26} suggest that there is no effect on birth weight when fewer than two or three drinks a day are taken, and that there is at most a small effect at higher levels of consumption. This conclusion remains compatible with the positive studies.^{6,7}

The small increase in risk, with evidence of dose-response, suggests that heavy coffee consumption may have a small effect on birth weight. This finding is compatible with reported increases in risks by a factor of 1.24 for heavy coffee consumption⁸ and by a factor of 1.58 for frequent coffee consumption.¹⁶ In a study of total caffeine consumption, however, a fourfold increase in risk of low birth weight was found with the consumption of caffeine equivalent to more than three cups of coffee a day.¹⁴ In Quebec women in the Canada Nutrition Survey, total caffeine consumption and coffee consumption were highly correlated ($r = .98$) (Health and Welfare Canada, personal communication). The difference between these two measures is thus unlikely to explain the higher risk found by the latter¹⁴ study. □

TABLE 2—Risk of Prematurity by Cigarette Consumption

	No. Pregnancies	% Premature	OR	95% CI	Change ^a
Low birth weight					
Nonsmoker	26 089	3.6	1.00		73.4 g
< 10 per day	3 147	6.1	1.64	1.39–1.93	–37.1 g
10–19 per day	5 042	9.2	2.39	2.12–2.71	–138.3 g
20+ per day	6 167	11.2	2.85	2.53–3.21	–178.7 g
LBWGA					
Nonsmoker	26 089	3.0	1.00		59.8 g
< 10 per day	3 147	6.3	1.97	1.68–2.33	–29.5 g
10–19 per day	5 042	8.6	2.58	2.27–2.93	–107.2 g
20+ per day	6 167	10.8	3.19	2.82–3.60	–150.4 g
Preterm birth					
Nonsmoker	26 089	6.0	1.00		–0.08 wk
< 10 per day	3 147	7.4	1.22	1.05–1.41	–0.08 wk
10–19 per day	5 042	9.1	1.43	1.27–1.60	–0.20 wk
20+ per day	6 167	8.9	1.33	1.18–1.49	–0.16 wk

Note. OR = odds ratio, estimated by logistic regression with all factors, including age, pregnancy order, previous spontaneous abortion, previous low-birth-weight infant, prepregnancy weight, ethnic group, education employment at start of pregnancy, and alcohol and coffee consumption, in the model. CI = confidence interval. LBWGA = low birth weight for gestational age.
^aMean, adjusted for other risk factors by analysis of variance.

TABLE 3—Risk of Low Birth Weight by Changes in Smoking Habit at the Start of Pregnancy

Cigarettes per Day before Pregnancy	Cigarettes per Day in First Trimester			
	0	1–9	10–19	20+
0	1	—	—	—
1–9	0.64 (0.37–1.10)	1.15 (0.79–1.66)	—	—
10–19	0.98 (0.65–1.50)	1.81 (1.34–2.45)	2.20 (1.80–2.68)	—
20+	0.98 (0.70–1.39)	2.18 (1.60–2.96)	2.67 (2.40–3.38)	3.05 (2.66–3.50)

Note. Figures given in the table are odds ratios adjusted for confounders, relative to women smoking in neither period. 95% confidence intervals are given in parentheses.

TABLE 4—Risk of Low Birth Weight by Changes in Smoking Habits between the First and Second Trimester

Cigarettes per Day in First Trimester	Cigarettes per Day in Second Trimester			
	0	1–9	10–19	20+
0	1	—	—	—
1–9	0.95 (0.53–1.71)	1.05 (0.58–1.89)	—	—
10–19	1.22 (0.68–2.21)	2.98 (1.87–4.75)	2.70 (2.32–3.14)	—
20+	1.19 (0.68–2.10)	2.34 (1.21–4.53)	3.43 (2.60–4.53)	3.26 (2.83–3.75)

Note. Figures given in the table are odds ratios adjusted for confounders, relative to women smoking in neither period. 95% confidence intervals are given in parentheses.

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TABLE 5—Risk of Prematurity by Alcohol Consumption

	No. Pregnancies	% Premature	OR	95% CI	Change ^a
Low Birth Weight					
None	27 804	6.0	1.00		—10.2 g
1–2 drinks per week	7 330	4.4	0.79	0.70–0.90	21.3 g
3–6 drinks per week	3 970	5.0	0.87	0.74–1.01	24.8 g
7–20 drinks per week	1 203	6.3	1.03	0.80–1.31	24.9 g
21+ drinks per week	138	11.6	1.59	0.92–2.73	0.5 g
LBWGA					
None	27 804	5.5	1.00		–5.8 g
1–2 drinks per week	7 330	4.1	0.80	0.70–0.91	11.6 g
3–6 drinks per week	3 970	4.5	0.85	0.72–1.00	12.9 g
7–20 drinks per week	1 203	6.0	1.02	0.79–1.31	19.0 g
21+ drinks per week	138	8.7	1.19	0.65–2.19	20.2 g
Preterm Birth					
None	27 804	7.3	1.00		–0.04 wk
1–2 drinks per week	7 330	5.8	0.86	0.77–0.96	0.07 wk
3–6 drinks per week	3 970	6.2	0.90	0.79–1.04	0.10 wk
7–20 drinks per week	1 203	7.0	0.99	0.78–1.24	0.09 wk
21+ drinks per week	138	9.4	1.21	0.68–2.17	–0.01 wk

Note. OR = odds ratio, estimated by logistic regression with all factors, including age, pregnancy order, previous spontaneous abortion, previous low-birth-weight infant, prepregnancy weight, ethnic group, education, employment at start of pregnancy, and cigarette and coffee consumption in the model. CI = confidence interval. LBWGA = low birth weight for gestational age.
^aMean, adjusted for other risk factors by analysis of variance.

TABLE 6—Risk of Prematurity by Coffee Consumption

	No. Pregnancies	% Premature	OR	95% CI	Change ^a
Low Birth Weight					
None	17 518	5.0	1.00		16.3 g
1–2 cups per day	7 471	5.5	1.05	0.95–1.16	–4.0 g
3–4 cups per day	3 743	7.5	1.08	0.93–1.25	–33.7 g
5–9 cups per day	1 380	9.5	1.13	0.92–1.39	–46.2 g
10+ cups per day	333	12.9	1.43	1.02–2.02	–81.9 g
LBWGA					
None	17 518	4.5	1.00		16.8 g
1–2 cups per day	17 471	4.9	1.05	0.94–1.16	–3.9 g
3–4 cups per day	3 743	7.2	1.15	0.99–1.34	–37.3 g
5–9 cups per day	1 380	10.0	1.34	1.10–1.65	–46.0 g
10+ cups per day	333	11.4	1.39	0.97–1.98	–73.0 g
Preterm Birth					
None	17 518	6.7	1.00		0.00 wk
1–2 cups per day	17 471	6.7	1.00	0.92–1.09	0.00 wk
3–4 cups per day	3 743	8.2	1.08	0.94–1.24	0.03 wk
5–9 cups per day	1 380	8.5	1.06	0.86–1.30	–0.01 wk
10+ cups per day	333	10.5	1.24	0.86–1.79	–0.06 wk

Note. OR = odds ratio, estimated by logistic regression with all factors, including age, pregnancy order, previous spontaneous abortion, previous low-birth-weight infant, prepregnancy weight, ethnic group, education, employment at start of pregnancy, and cigarette and alcohol consumption in the model. CI = confidence interval. LBWGA = low birth weight for gestational age.
^aMean, adjusted for other risk factors by analysis of variance.

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